

HARRIS®

TECHNOLOGY TO CONNECT,
INFORM AND PROTECT™

ENVI®

POCKET GUIDE

VOLUME 1 | BASICS

Authored as a Derivative from ENVI Bootcamp & ENVI Documentation Center By:
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In association with the U.S. Army TWI Program.

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The ENVI® Pocket Guide is a quick reference booklet not intended to be read from cover to cover although it can be. The intent is to provide users with succinct steps on how to accomplish common tasks in ENVI.

If you need or desire comprehensive explanations of tasks from this guide refer to the following resources:

ENVI Documentation Center
harrisgeospatial.com/docs

ENVI Tutorials
harrisgeospatial.com/docs/tutorials.html

ENVI Videos
harrisgeospatial.com/Learn/Videos.aspx

Computer Based Training
harrisgeospatial.com/Learn/Training/cbt.aspx

ENVI Help Articles
harrisgeospatial.com/Support

Tech Support
(+1)303-413-3920

Email Support
support@harrisgeospatial.com

ENVI® INTERFACE KEY

Some numbers represent GUI groups separated by commas from left to right.

1. Open file, Data manager, Chip extent to new file

2. Cursor Value, Pan, Fly, Rotate

3. Zoom; Fixed In, Fixed Out, Full Extent, Percent/ Ratio

4. North Up, Type or Preset Angle

5. Profile; Spectral Profile, Scatter Plot, ROI, Feature Count

6. Digitizing; Vectors, Annotations

7. Go To Coordinate

8. Transparency; portal, blend, flicker, swipe & mensuration

9. Tools/ Toolbox; Image Processing & Tools Search*

10. 3 x Inputs for Cursor Value; Right click to personalize

11. Layer Manager

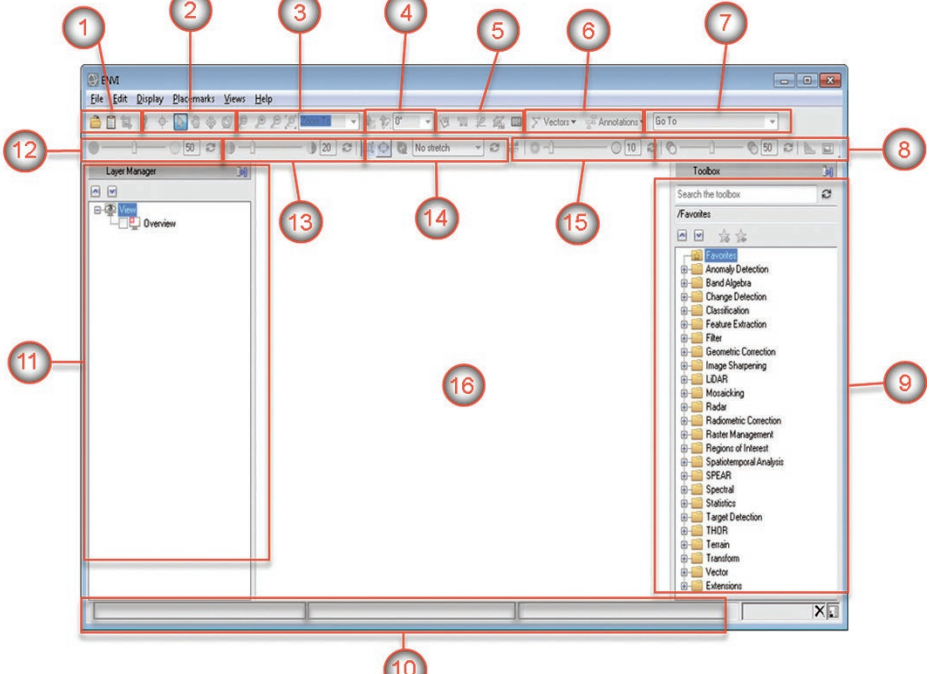
12. Brightness

13. Contrast

14. Histogram Stretch

15. Sharpen

16. Data Viewer; Use View from Main Menu to add multiple


1
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6
7
8
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10
11
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15
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ENVI
File Edit Display Placemarks Views Help
Vectors
Annotations
Go To
No stretch
Layer Manager
View
Overview
Toolbox
Search the toolbox
/Favorites
Favorites
Anomaly Detection
Band Algebra
Change Detection
Classification
Feature Extraction
Filter
Geometric Correction
Image Sharpening
LiDAR
Mosaicking
Radar
Radiometric Correction
Raster Management
Regions of Interest
Spatiotemporal Analysis
SPEAR
Spectral
Statistics
Target Detection
THOR
Terrain
Transform
Vector
Extensions

GETTING STARTED

OPENING ENVI

1. On Windows OS click Start > All Programs > ENVI 5.x > ENVI for ArcGIS® > ENVI 5.x (32-Bit). This method allows users to interface with ArcMap.

2. To open ENVI in (64-Bit) mode click Start > All Programs > ENVI 5.x > 64-Bit > ENVI 5.x (64-Bit). This method DOES NOT allow users to interface with ArcMap.

3. To open ENVI programmatically via IDL click Start > All Programs > IDL 8.x > IDL 8.x. The IDL window will appear. Within the IDL Console Tab type the following code: `IDL> E = ENVI()`

4. Hit ENTER and ENVI will soon launch.

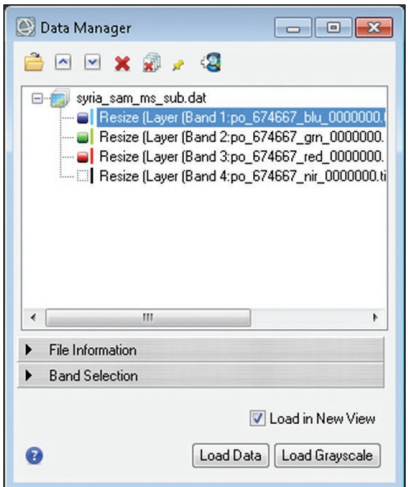
This is an introduction to familiarize users with common methods for opening ENVI, loading data, navigating, and performing stretches.

LOADING & REMOVING DATA

5. To load data click the Open File icon . An explorer window will open. Navigate to the disk location of the file you wish to open.

6. Click the file and click Open. ENVI's native file format is .dat but ENVI recognizes and reads most common formats such as: (.img, .ntf, rpf, .tiff, .las, .dt, dppdb, .sid, .shp, .evf) and many more.

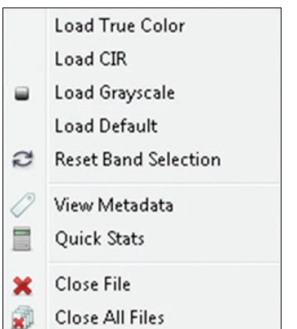
7. Another method is by clicking the Data Manager icon . Click Data Manager and the dialog appears, as seen on the previous page.



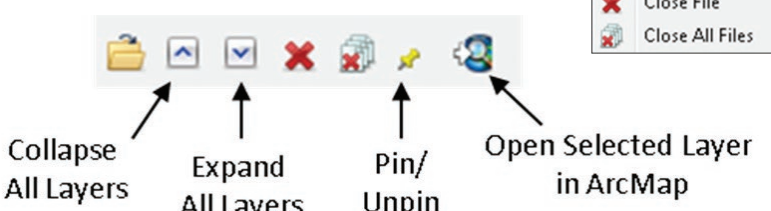
Windows Data Drag & Drop Functionality is fully supported in ENVI.

8. This allows users to Load additional layers by clicking or explore different band combinations within the current view or a new view via intuitive manipulation and clicking Load Data.

9. Provided complete metadata users can also Right Click existing layers to load preset band combinations such as:

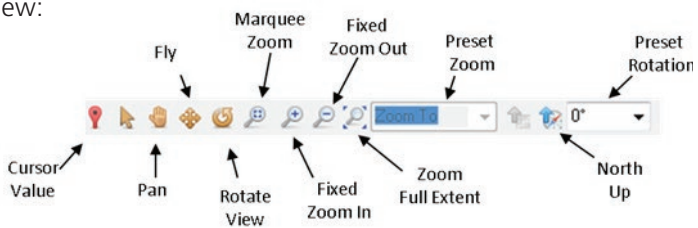


10. Users may also use the Data Manager to perform the following:

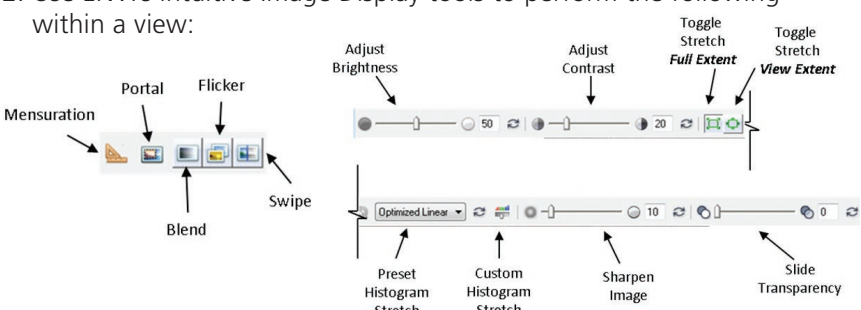


NAVIGATING WITHIN A VIEW

11. Use ENVI's intuitive navigation tools to perform the following within a view:



12. Use ENVI's intuitive Image Display tools to perform the following within a view:

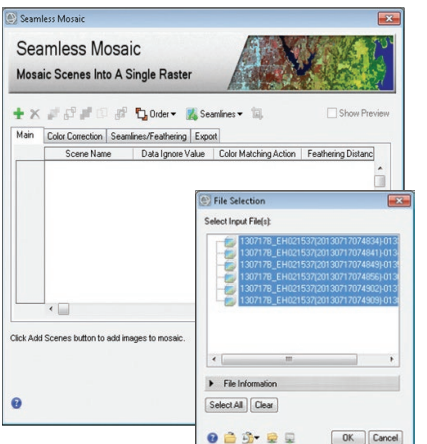


MOSAIC

1. From the Toolbox, select Mosaicking > Seamless Mosaic. The Seamless Mosaic panel appears. You will set all mosaic options within this single panel. Click the Help button in the lower-left corner of the panel if you have further questions.

2. Click the Add Scenes button .

3. Click the Open File icon  in the File Selection dialog. A file selection dialog appears.



Before beginning, some imagery requires preparation such as cropping to remove distorted edges to ensure optimal output results.

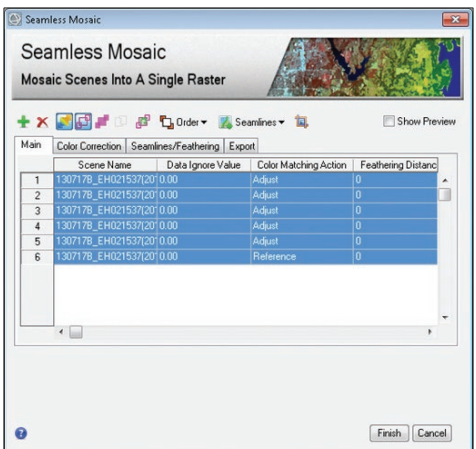
4. Navigate to the folder that contains the image data, and use the Ctrl or Shift key to select the files you need to mosaic. Click Open. The File Selection dialog lists all selected scenes.

5. Click the Select All button.

6. Click OK.

7. Your dialog should now look similar to the example on this page. Highlight all images using the main column.

8. Right Click the Data Ignore Value column header and set your value. In most cases 0 will be used.



9. Next highlight all images then Right Click > Feathering Distance and set the value between 10-20 pixels or more depending on image quality and resolution.

10. Click the Color Correction Tab and toggle Histogram Matching. Go back to Main Tab and set your desired reference image under the Color Matching Action column. All others will be matched.

11. Next click the Seamless dropdown arrow and select Auto Generate Seamlines. Then Toggle the Show Preview radial button.

12. The system may take a few minutes to generate a preview depending on your system specifications. Use the zoom Tools to visually inspect before exporting.

13. If you are not satisfied during visual inspection go back to the Main tab and tweak the reference image under the Color Matching Action column and/ or adjust Feathering Distances. If Ignoring 0 Value doesn't completely eliminated edge noise you may need to crop the input image(s) in question before mosaicking.

14. If you are satisfied with the preview proceed to the Export Tab. (Optional) Use Crop Tool before exporting to designate a perfectly square or rectangle output. Then select ENVI or TIFF Output format. Choose desired Resample Method. Browse to your Output Directory, name the output then click Finished.

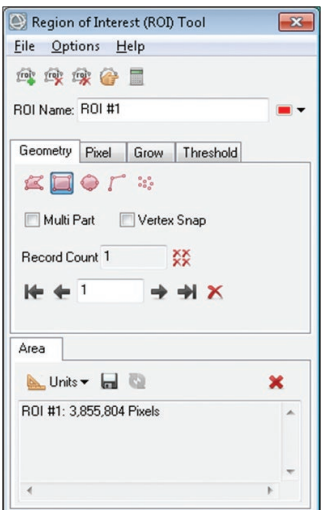
SUBSET

1. Open the ROI Tool and Draw a square or polygon over the extent of the image you want to subset. Double Click when satisfied with drawing. Name the ROI you've just created or leave it set to the default ROI #1.

2. From the Toolbox, select Regions of Interest > Subset Data from ROIs

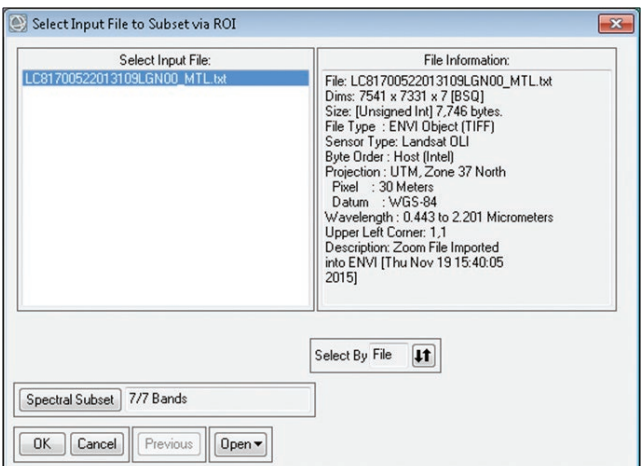
3. Under Select Input File highlight the image that will be subset.

Subset will be performed using Regions of Interest (ROI). Supported ROI inputs include .xml files created with the ROI Tool, .shp files, and ENVI Classic .roi and .evf files.



4. The Select Input File to Subset via ROI dialog also gives you the option to Select By: File or Band using this ⇅ button. You may also specify bands by clicking the Spectral Subset button.

5. Accept all defaults and Click OK.



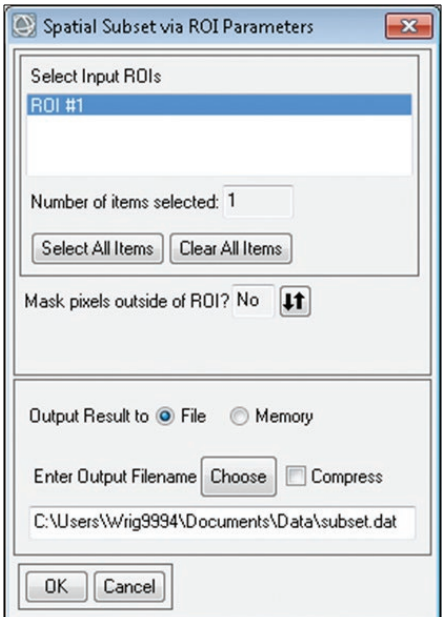
6. Highlight ROI #1 on the Spatial Subset via ROI Parameters dialog.

7. Enter Output Filename by clicking Choose.

8. Navigate to desired output directory and name the file something like "subset.dat" as seen in the example.

9. Click OK

10. The newly created subset will be added to your View once processing is complete.

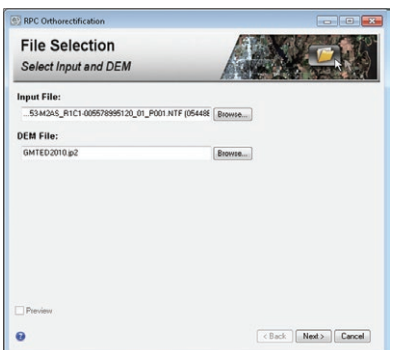


ORTHORECTIFY

1. Open the image you will orthorectify along with the associated DEM if you have one.

2. From the Toolbox, select Geometric Correction > Orthorectification > RPC Orthorectification Workflow. The File Selection dialog will appear.

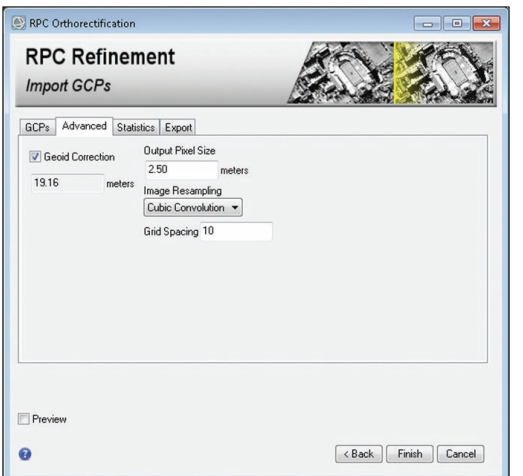
3. Click the Browse button to select your image and your DEM. If you do not have a DEM use the default GMTED2010.jp2 provided by ENVI.



To perform orthorectification the input image must have Rational Polynomial Coefficients (RPC). Examine the metadata to ensure this information is present. If you do not have elevation data ENVI provides a default 30 arc seconds (1km) DEM called GMTED2010.jp2 which is saved during software installation.

4. Click Next to proceed to RPC Refinement. If you have (Optional) Ground Control Points (GPC) which improves accuracy, press to Load them under the GPC tab.

5. Otherwise Click the Advanced Tab. ENVI programmatically calculates Geoid Correction based on the Earth Gravitational Model (EGM) 1996. Accept the default or input your own Geoid Correction if it is more accurate.

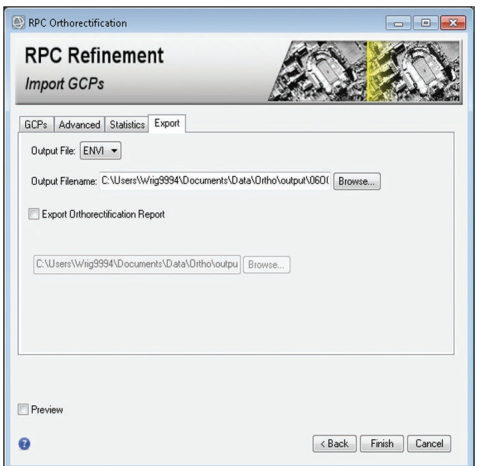


6. In this process we will set the Image Resampling method to Cubic Convolution. Compare other methods as you deem necessary.

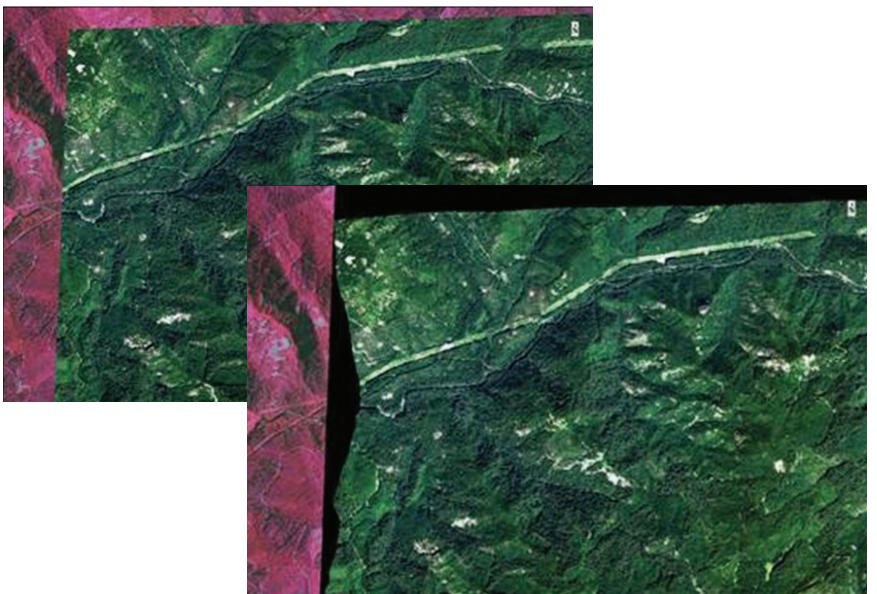
7. Click the Export Tab.

8. Click Browse to navigate to your desired output directory. Name your output <YOUR_FILE>_ortho.dat.

9. Optionally toggle Preview to open a movable portal to visually inspect results. Click Finish.



Before & After Ortho-Examples:

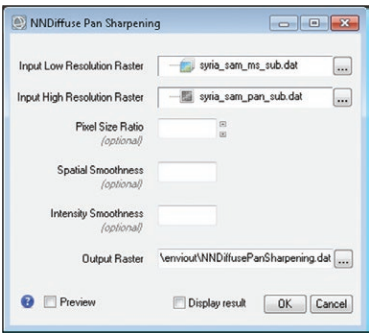


PANCHROMATIC SHARPEN

METHOD 1

1. Open your low res (ms) – multi-spectral image in an ENVI view.

2. From the Toolbox, Search for NNDiffuse or select Image Sharpening > NNDiffuse Pan Sharpening. The NNDiffuse Pan Sharpening wizard will appear.



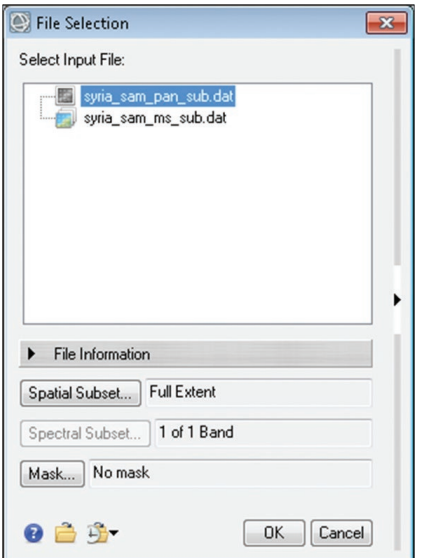
Pan Sharpening is an image merging process that allows users to create a new image by combining hi-res grayscale images with low-res color images to produce a color image for literal analysis. ENVI provides multiple methods. Only Two of many have been selected for this guide as a basis for conceptual understanding. Proceed with Method 1 if your images DO NOT require co-registration or atmospheric correction. Otherwise use Method 2.

3. Next select the ellipses button … next to the Input High Resolution Raster.

4. Click  and navigate to your hi res panchromatic image in the File Selection Window.

5. Click OK on the File Selection Window.

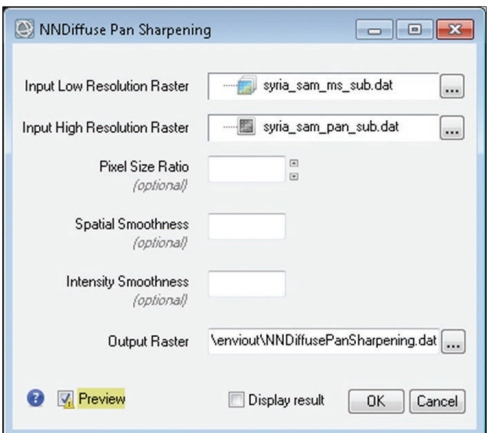
6. In ENVI, use  marquee zoom to zoom in on any area of your currently loaded low res ms image.



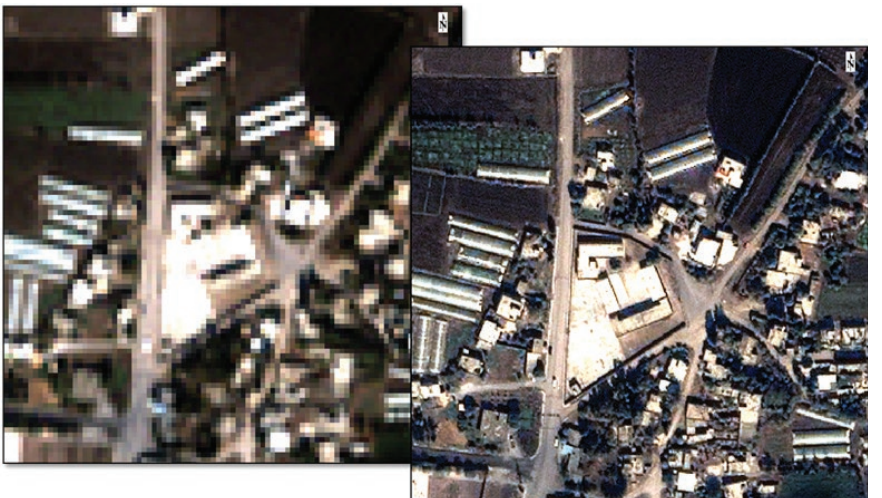
7. Next check Preview in the NNDiffuse Pan Sharpening Window. This will allow you to visually inspect results before processing the data.

8. See the 'before & after' samples provide.

9. If you are satisfied with the Preview results Click OK in the NNDiffuse window.



Before & After NNDiffuse Pan Sharpen Examples:

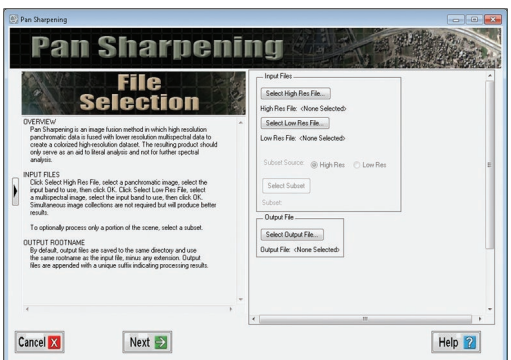


METHOD 2

1. Open both images, hi-res panchromatic and low res – multi-spectral in ENVI.

2. From the Toolbox, select SPEAR > SPEAR Pan Sharpening. The Pan Sharpening wizard will appear.

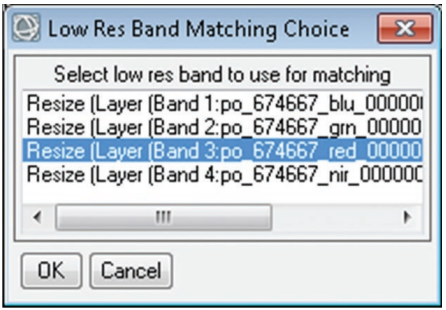
3. Click the Select High Res File choose your panchromatic image then click OK. Next click Select Low Res File, choose your multispectral image then click OK.



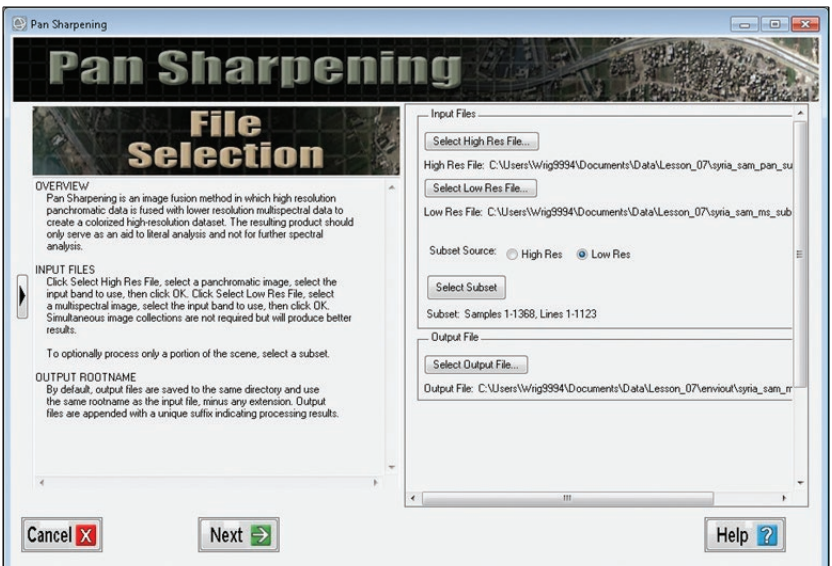
In this workflow images will be co-registered and atmospherically corrected beforehand.

4. The Low Res Band Matching Choice dialog will open. It is best practice to choose Band 3 because spectral properties in the red band closely match those of panchromatic images and eases co-registration. Click OK.

5. Click Select Output File, navigate to your desired output directory and name the file *_pansharp.



6. Your window should resemble the following Pan Sharpening wizard.



7. Click Next. In the following window toggle Select tie points automatically.

8. Next ensure Use seed points is checked and Click Auto-Generate Seed Points. This allows ENVI to estimate GCP's. Alternatively you can choose your own by clicking Select Seed Points.

9. Your window should resemble the following Pan Sharpening wizard.

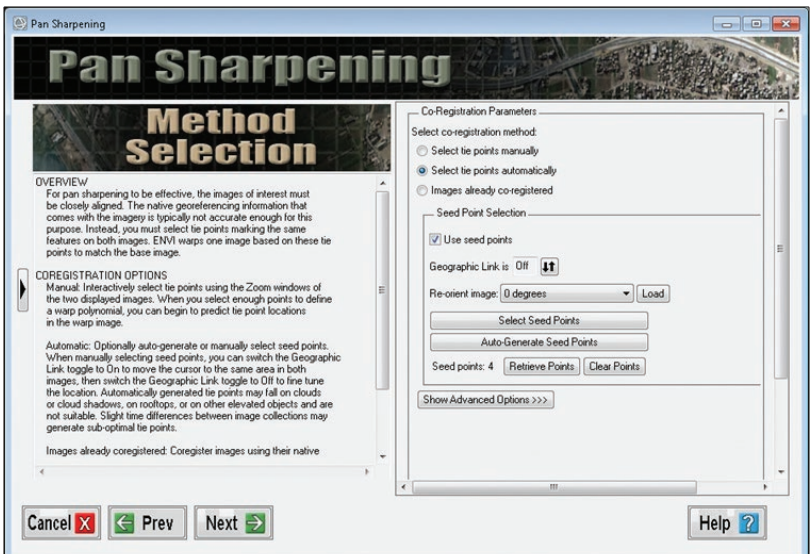
10. Click Next. A series of windows will open in addition to the Pan Sharpening wizard. Bring the Image to Image GCP List forward.

11. Click Options > Order Points by Error and the seeds with the highest RMS Error are then brought to the top of the list.

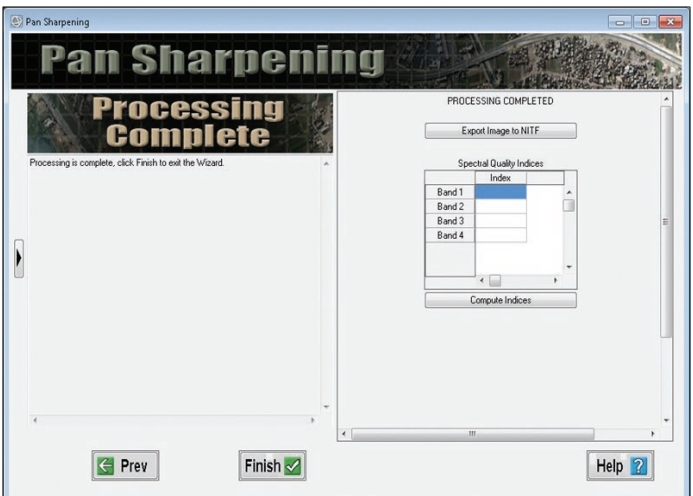
12. Highlight Seeds with RMS Error higher than 3 and Click Delete.

13. Next bring forward the Pan Sharpening wizard and set Maximum allowable RMS per GCP: to 1.0 and click Apply.

14. Choose Warp Parameters you desire. In this exercise set Method: to Polynomial and Interpolation: to Cubic Convolution then Click Next.



15. In the final Pan Sharpening wizard window choose Sharpening Method. In this exercise select Gram-Schmidt and Click Next. Once Processing is complete Export the image to NITF or click File > Save Image As on Classic View # 1 to save as an image file or a postscript file.



CHANGE DETECTION

1. Click the Open File icon in ENVI and open two images over the same geographic region on different dates.

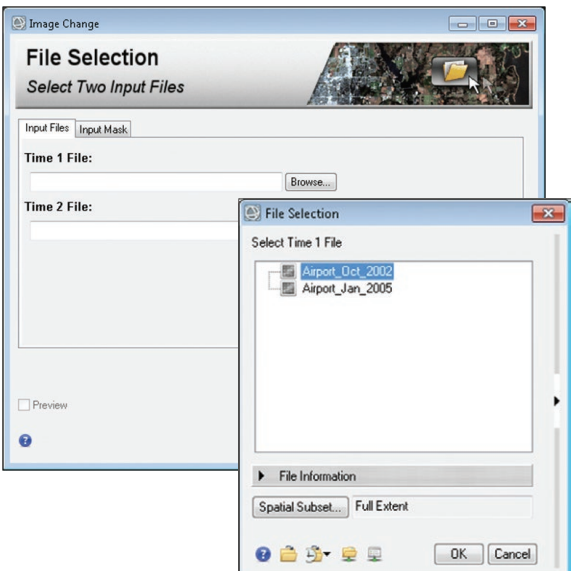
2. From the Toolbox, select Change Detection > Image Change Workflow. The Image Change wizard will appear.

3. Click the Browse next to Time #1 File and select the oldest/first image. Click OK.

Steps laid out in this section result in the production of a 2-Color Multi View (2CMV) Change Detection. The end product will be a standard red and blue image based on changes that have taken place between images captured on two separate dates. Remember the phrase "red has fled" and "blue is new". 'This exercise assumes the images are already co-registered. If your image is not co-registered do so before proceeding.

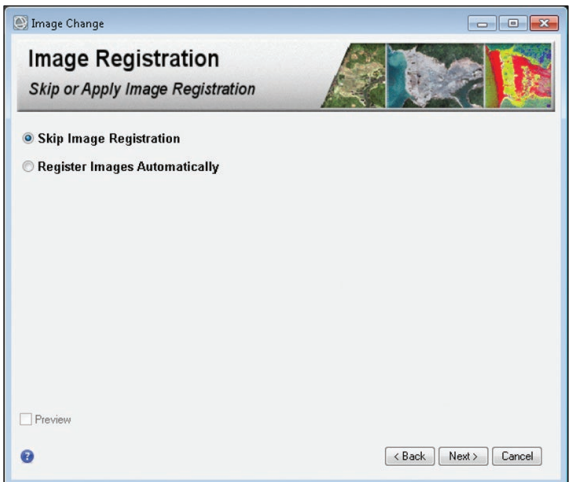
4. Repeat previous selection steps for Time #2 File but select the newer/second image. Then Click Next.

5. The Image Registration window will appear. If your images require registration toggle Register Images Automatically. Otherwise toggle Skip Image Registration.



6. Click Next and the Change Method Choice window will appear.

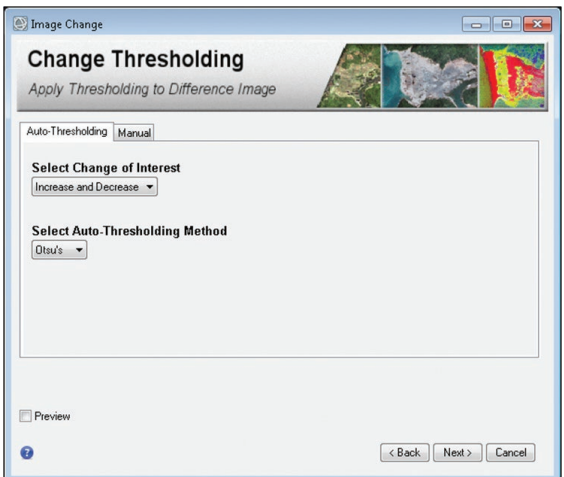
7. Toggle Image Difference then Click Next. Accept the default Difference of Input Band and Band 1 under Select Input Band and Click Next.



8. The Thresholding or Export window will appear next. Accept default Apply Thresholding and Click Next. The Change Thresholding window will appear allowing you to either enter a Manual threshold or use Auto-Thresholding.

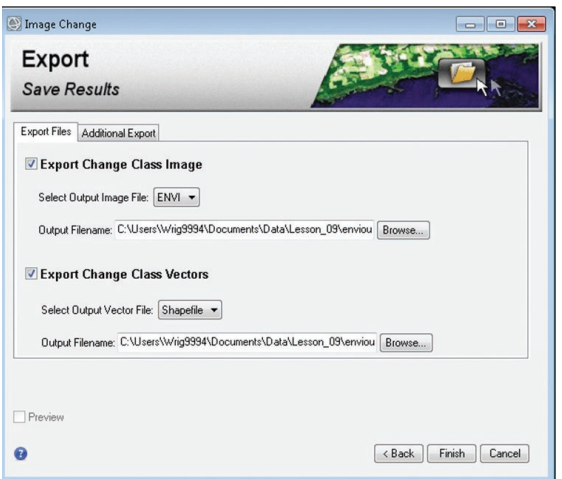


9. Under Select Change of Interest you may choose Increase and Decrease, Increase Only or Decrease Only. Increase and decrease will return both red and blue 2CMV. Red indicates decrease and blue indicate increase (red has fled, blue is new).



10. Under Select Auto-Thresholding Method accept default Otsu's. For a comprehensive explanation of Otsu's, Tsai's, Kapur's and Kittler's thresholding methods visit ENVI Tutorials online. Click Next.

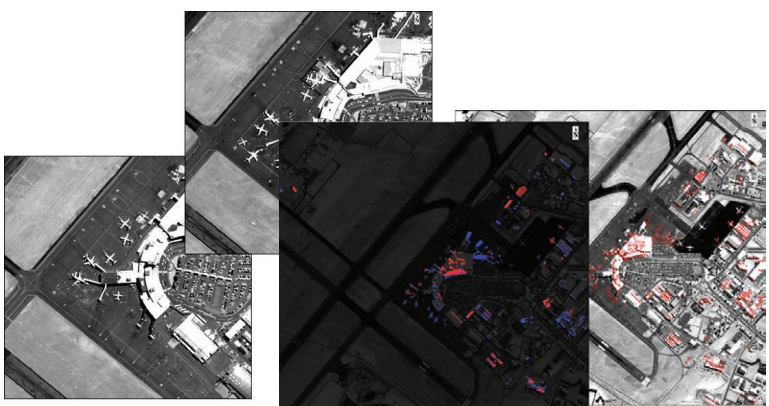
11. The Cleanup window will now appear enabling you to refine results. Accept the defaults and Click Next or toggle Preview and manually tune to your liking.



12. The Export window will now appear allowing you to save both image and vector outputs. Click Browse on both the Export Change Class Image and Export Change Class Vectors and navigate to your output directory. Name the output files appropriately Click Open then Click Finish.

13. You may now use the transparency slider to visually inspect the results.

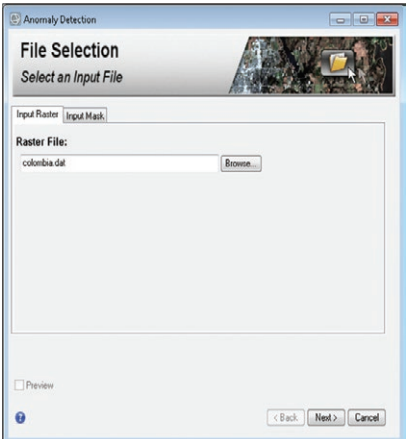
Old Image, New Image, Change Detection Examples:



ANOMALY DETECTION

1. Open your image in ENVI thru the data manager or by dragging and dropping from a Windows Explorer or ArcCatalog.

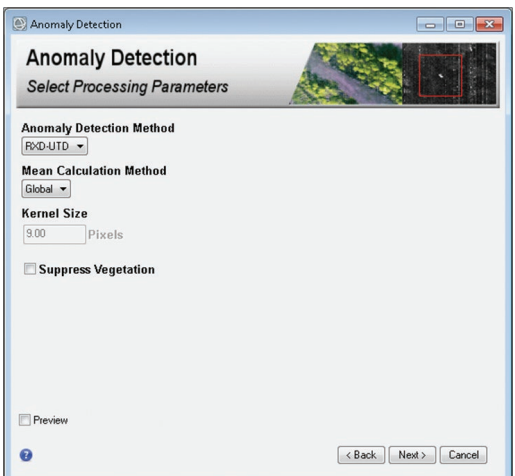
2. From the Toolbox, Click > Anomaly Detection > Anomaly Detection Workflow. The Anomaly Detection wizard will appear. Click Next.



Anomaly detection is a process performed on imagery to highlight significant or unnatural spectral differences in pixels versus neighboring values. Anomaly detection is useful in determining things such as disturbed earth or spikes in energy levels versus surroundings, for example. This process is useful in narrowing down searches to determine if and where further investigation is warranted.

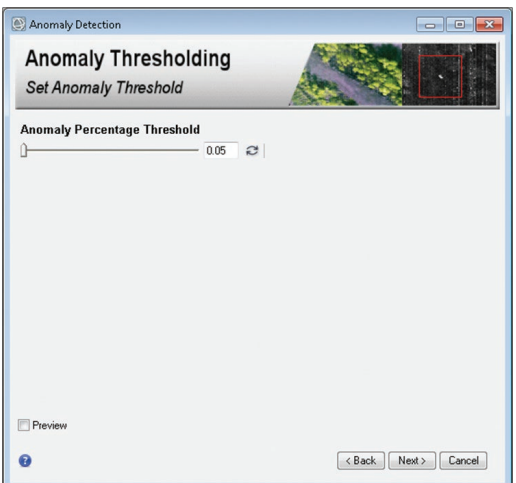
3. Select RXD-UTD algorithm under Anomaly Detection Method. For a detailed explanation of this and other algorithms for this workflow visit the ENVI Documentation Center online.

4. Accept Global under Mean Calculation Method to process the spectrum of the full dataset. Suppress Vegetation if your image deems it necessary. Click Next.

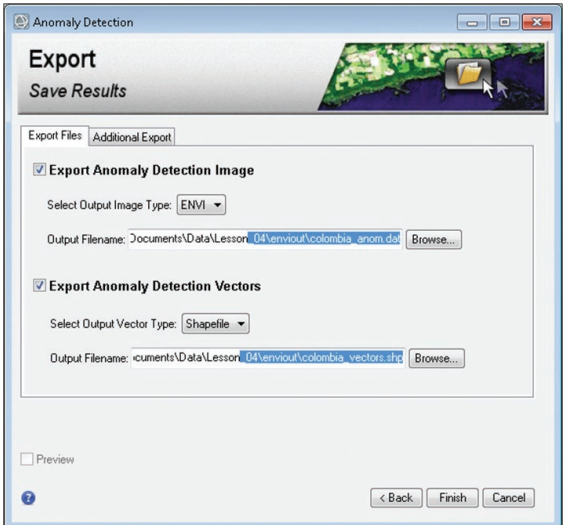


5. Ensure Anomaly Percentage Threshold is set to default 0.05 or adjust thru trial and error using the Next and Back buttons to your liking. The higher the threshold is set, the more data will be perceived as defects. Experiment with the Preview checkbox. Click Next.

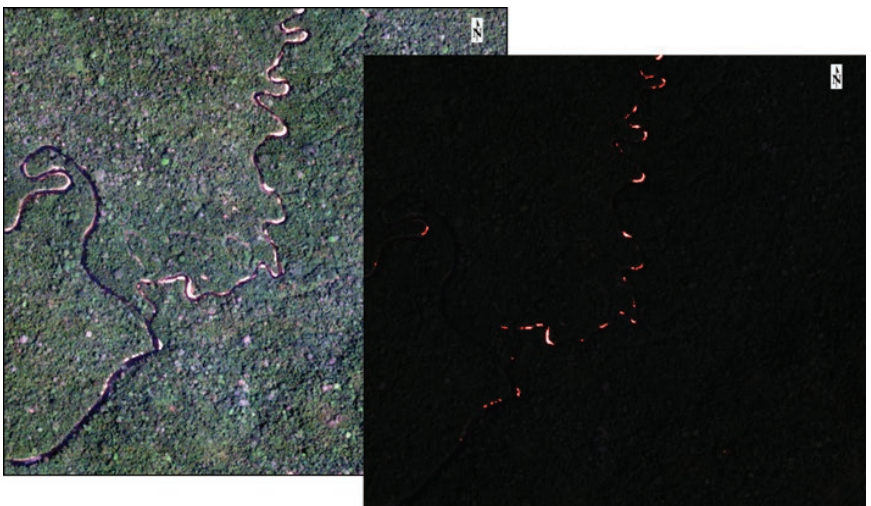
6. On the Export window use the Browse button to specify output filenames for both your new anomaly image and vector datasets. Click Finish.



7. The results will automatically open in ENVI for further investigation and/or exploitation. White in the imagery indicates an anomaly. Red in the vector indicates an anomaly.



Input Image, Anomaly Image overlayed with Anomaly Vector Examples:

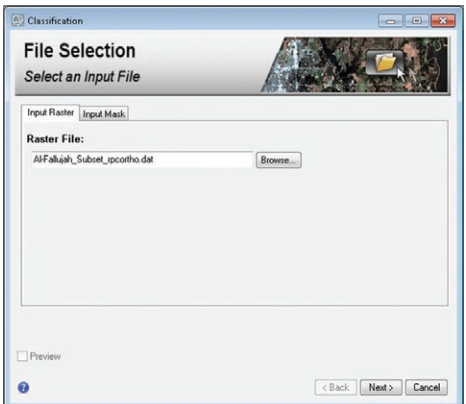


TERRAIN CATEGORIZATION

1. Open a color image in ENVI for classification.

2. From the Toolbox, Click Classification > Classification Workflow. The Classification wizard will appear. Click Next.

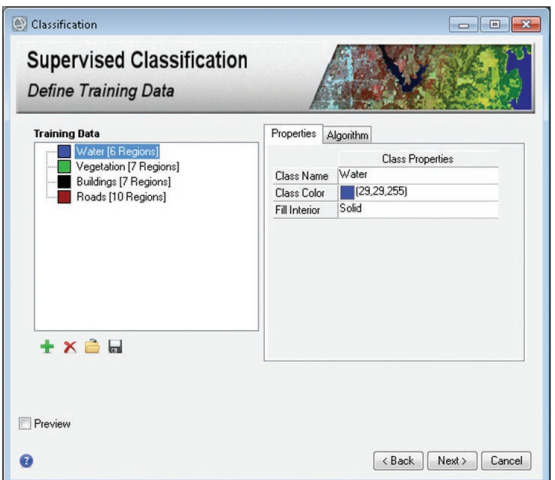
3. In the next window toggle Use Training Data to signify this is a 'Supervised' Classification. Click Next



ENVI provides the Classification Workflow to allow user to create a Landcover / Terrain Categorization (TERCAT). This process can be carried out by the software, 'Unsupervised' or by user assigned 'Spectra, 'Supervised". In this exercise we will conduct a 'Supervised' Classification.

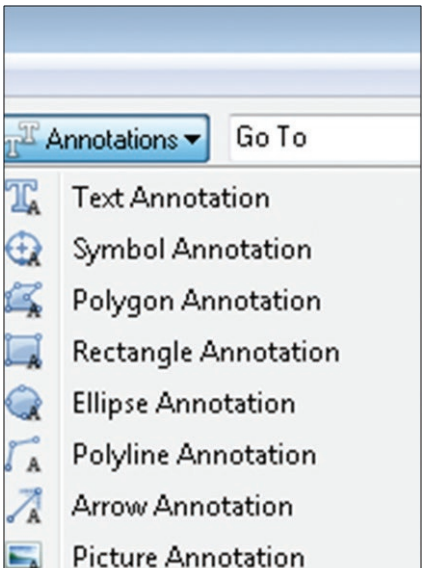
4. The Supervised Classification window will appear. You will use the ✚ to add Training Data classification(s). Assign Class Names per region to the right under Properties tab. Delete training data if necessary by highlighting item by item and pressing ✕.

5. Once desired classes have been created highlight one by one and go about the image to select spectra samples for each class using the ROI Annotation tools in tandem with the navigation tools to zoom and pan around.

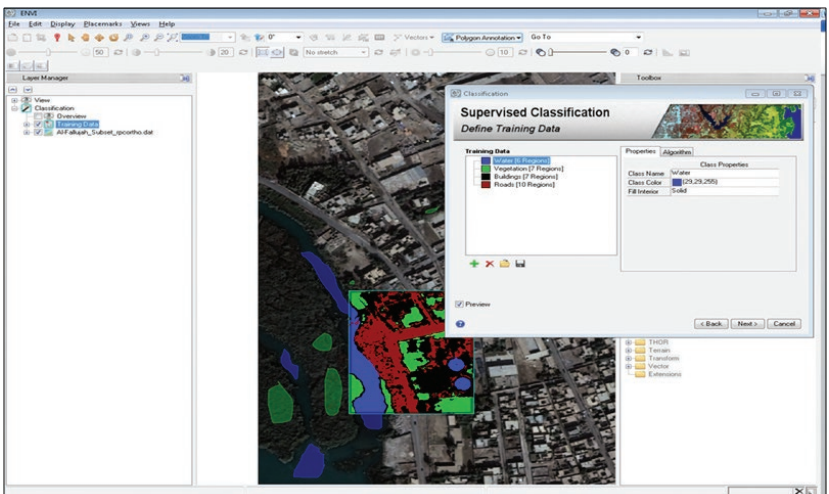


6. The mouse wheel is very useful in allowing users to zoom in and out based on the cursor position while in annotation mode.

7. Select 8 to 10 varying spectra for each class by simply drawing a polygon or rectangle then Right Click and select Accept or Delete.

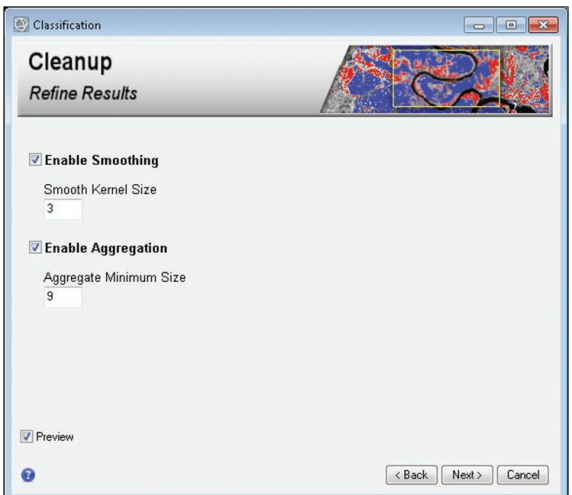


8. Once satisfied with spectral selection toggle the Preview box to launch a Portal within View one to inspect results so far. Drag the Portal around the View to inspect.

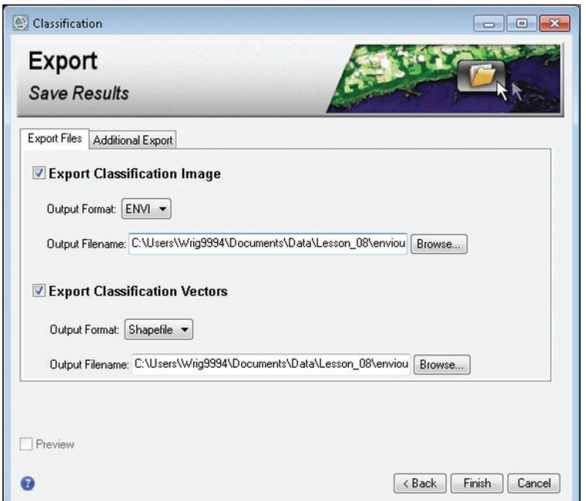


9. If you are not satisfied with Preview results you may use the icon to go about the view selecting and deleting specific ROI's if there is an issue.

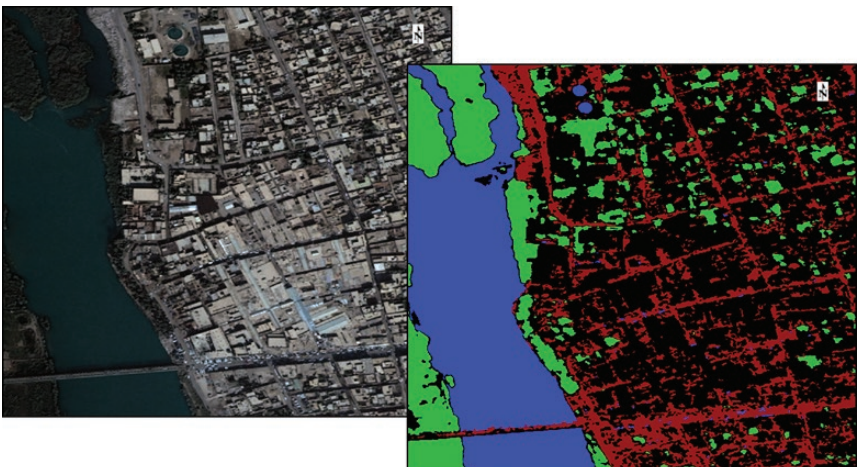
10. Click Next and the Cleanup window will appear. This window allows user to use smoothing algorithms to generalize if desired. Adjust or accept Defaults and Click Next.



11. On the Export window use the Browse button to specify output filenames for both your new anomaly image and vector datasets. Click Finish.



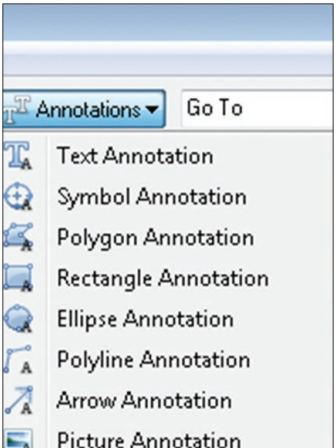
Input Image, New Image & Vectors TERCAT Examples:



EXPORT TO RPF

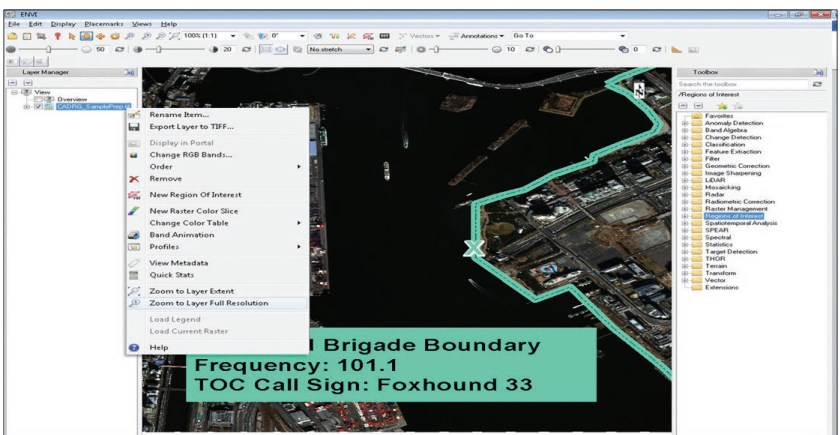
1. Generate a GEOTIFF with specialized vector overlays, drawings, pictures and/or text annotations. This can be accomplished in ENVI using the Annotations menu or ArcMap as long as the GEOTIFF is accompanied by a corresponding World File.

2. In ENVI Open the newly created GEOTIFF by selecting File > Open and navigate to the location on disk.



ENVI enables creation of the following RPF/CADRG Resolutions: (1: 5,000,000 GNC (754m), 1: 2,000,000 JNC (300m), 1: 1,000,000 ONC (150m), 1:500,000 TPC (75m), 1: 250,000 JOG (37.5m), 1: 100,000 TLM (15m) and 1: 50,000 TLM (7.5m). Quality will depend on scale and dpi of the input so take this into account during data preparation.

3. Right Click the newly opened file and select Zoom to Layer Full Resolution. Visually inspect the GEOTIFF. Next Zoom to Layer Extent. If you are not satisfied with the visual inspection make necessary adjustments such as dpi, overlays etc then export again before proceeding.



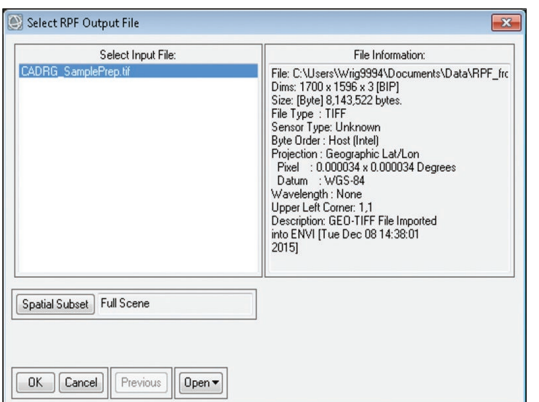
The GEOTIFF in this example was created in ArcMap at Scale 1: 25,000. When satisfied with the overlaid graphics and annotations, it was exported from Data View as a TIFF with Write World File toggled on the General Tab and Write GeoTiFF Tags toggled under the Format Tab. A 200 DPI was used.

4. Click File > Save As > CADRG assuming you are satisfied with the newly created GEOTIFF.

5. Highlight your GEOTIFF under Select Input File.

6. Click the OK Button.

7. The RPF (CADRG) Output Parameters dialog box will open.

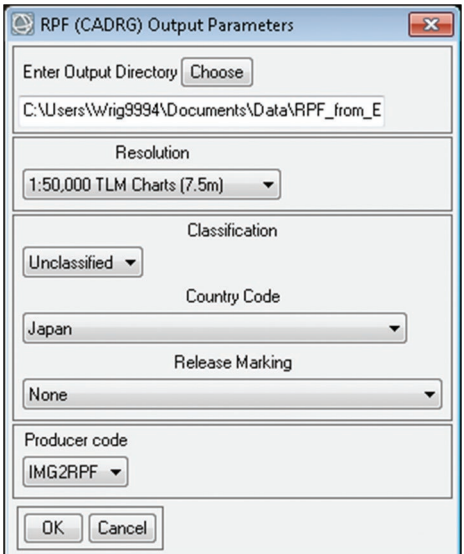


8. Choose your desired Output Directory. Set your desired Resolution from the drop down menu. In this example 1: 50,000 TLM Resolution was chosen.

9. Complete (Optional) Classification, Country Code and Release metadata.

10. Choose IMG2RPF as the Producer Code.

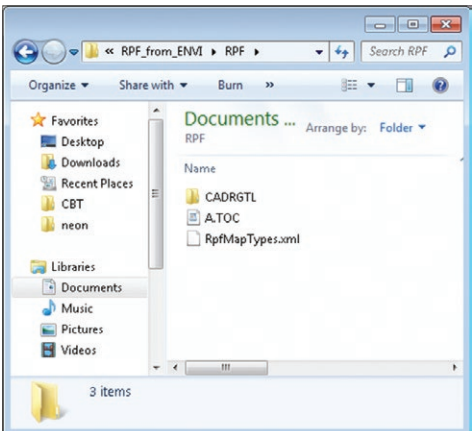
11. Click OK.



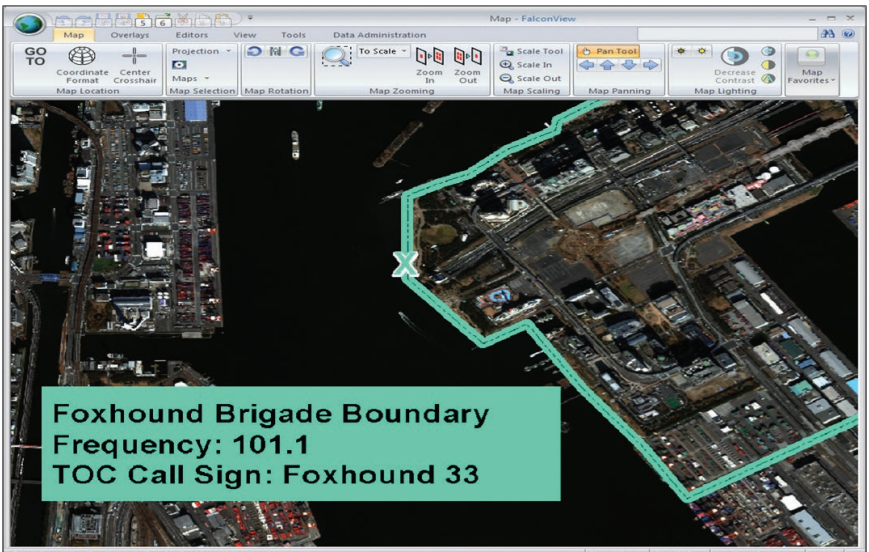
12. Once processing is complete navigate to the output directory and ensure you have the RPF data and the A.TOC.

13. Your Output directory's contents should look similar to the example to the right.

14. Visually inspect the newly created RPF data using Falconview. If dissatisfied make refinements and repeat the preceding steps. Once satisfied burn the entire RPF folder including the A.TOC file to disk to be loaded onto military aircraft and/or ground vehicles which rely on RPF data.



Results displayed in Falconview:



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